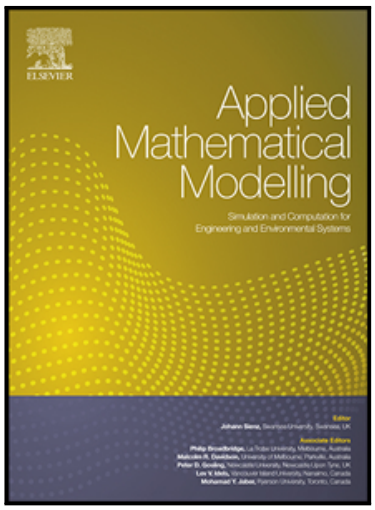

Buckling and vibration analysis of nonlocal axially functionally graded nanobeams based on Hencky-bar chain model

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We introduce Hencky bar net model for inhomogenous nanobeams for the first time

We show the formal analogy between Hencky bar net model and Finite Difference Model

We demonstrate the convergence to continuum plate results by increasing the grid size for any proposed example

The model deals with both stepped and tapered microbeams

Buckling and vibration analysis of nonlocal axially functionally graded nanobeams based on Hencky-bar chain model

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Abstract

Buckling and free vibration analyses of nonlocal axially functionally graded Euler nanobeams is the main objective of this paper. Due to its simplicity, the Eringen's differential constitutive model is adopted for describing the nonlocal size dependency of nanostructure beam. The nonlocal equilibrium equation is derived using the principle of the minimum potential energy principle, and discretized by using the link-spring model known in literature as Hencky bar-chain model. The general applicability of the proposed approach allows analyses of functional graded microbeams without any restriction on variability, boundary and loading conditions. A comparison with results available in the literature shows the reliability of the method.

Introduction.

Structural theories able to capture material scale effects in micro materials has gained considerable attention in recent years, due to its relevance in a wide range of application areas, including biomaterials, energy production, electronics, medicine. Such applications require a rigorous analysis of their structural behaviour, and the classical continuum mechanics is not able to take into account micro-scale size effects. For overcome this problem many higher order, nonlocal theories containing additional material constants has been developed: the modified couple stress theory [1], the strain gradient theory [2], the micropolar theory [3], the nonlocal elasticity theory [4] and the surface elasticity [5] are, among others, examples of theories proposed in literature.

In order to capture the scale effect, the nonlocal elasticity theory, proposed by Eringen [6] and Eringen and Edelen [7], assumes that the stress at a point is a function of strains at all points in the continuum, and introduce an internal length scale as material parameter into the constitutive